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CENTRAL INTELLIGENCE AGENCY
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REPORT
CD NO.

50X1-HUM

COUNTRY	USSR	DATE OF INFORMATION	1950
SUBJECT	Scientific - Astronomy, radiation	DATE DIST.	20 Nov 1950
HOW PUBLISHED	Thrice-monthly periodical		
WHERE PUBLISHED	Moscow	NO. OF PAGES	2
DATE PUBLISHED	21 Jul 1950		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Doklady Akademii Nauk SSSR, Vol LXXIII, No 3, 1950, pp 479-481.

POSSIBILITY OF DETERMINING DISTANCES TO POINT SOURCES OF RADIO WAVES IN THE GALAXY

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20 May 1950

[Digest]

The author proposes a method which would permit one, at least in principle, to solve the problem of finding the distances to the "point" emitters in question, which method is based on the analysis of the actual fluctuations in intensity of different waves. The radio waves in an interstellar gas (which is a dispersive medium for radio waves) are propagated with the group velocity $u = c \cdot n$, where $n^2 = 1 - 4\pi e^2 N / m\omega^2$ is the index of refraction of an ionized gas; N the concentration of free electrons; omega the angular frequency (see V. L. Ginzburg's theory of radio-wave propagation in the ionosphere in Teoriya rasprostraneniya radiovoln v ionosfere, 1949, p 185). If the point emitter of radio waves (a star) is located at a distance S from us, then the time of propagation of the waves will be, from the above two relations:

$$t = \frac{S_1}{c} + \frac{1.59 \times 10^9}{c\omega^2} \int N(S)\, dS \quad (\text{since } u = dS/dt, \text{ etc}).$$

Apparently, then, simultaneous emissions of radio radiations from a point source of various waves will not all reach the earth at the same time; the longer waves will be retarded. The relative retardation no Δt corresponding to two frequencies w_1 and w_2 (first greater) and due to a difference in group velocities will be:

$$\Delta t = \frac{1.59 \times 10^9}{c} \left(\frac{1}{W_2^2} - \frac{1}{W_1^2} \right) \int_0^{S_1} N(S)\, dS$$

Thus, the effect of retardation is accumulative, with increase in the "optical distance" $\int_0^{S_1} N(S) dS$. Obviously, we can find the distance S_1 by measuring on a "registrogramm" the relative retardations. As an example, consider the

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excellently correlated recordings of fluctuations in radio waves from a point emitter in Cygnus giving waves 3.7 and 6.7 meters (see Smith, Nature, 163, 422, 1950). We can take $\Delta t < 5$ sec; setting $w_1 = 5.10 \times 10^8$/sec and $w_2 = 2.82 \times 10^8$/sec we obtain: $\int_0^{S_1} N(S)\,dS < 1.1 \times 10^{19}/cm^2$. Assuming $N(S) = 10$/cu cm (see Strömgren, <u>Astroph J</u>, 108, 242, 1948), we see that $S_1 < 10^{20}$ cm (35 parsec).

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